SECTION 27 41 16.63 - Integrated Audio-Video Systems and Equipment for Stadiums and Arenas

PART 1 GENERAL

1.1 GENERAL

A. Coordination, provision, final engineering, installation, observation, testing, instruction, and warranties of a high quality Sound System

B. All materials, equipment, transport and labor necessary to accomplish this and have a complete and working system.

C. Each of the following:
1. Required licenses and permits including payment of charges and fees
2. Verification of dimensions and conditions at the job site
3. Provision of submittal information
4. Installation in accordance with the contract documents, manufacturer's recommendations, applicable codes and authority having jurisdiction.
5. Documented sound system tests and adjustments.
6. Instruction of operating personnel
7. Provision of manuals
8. Maintenance services and warranty

1.2 REFERENCES

A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
1. National Electric Code (NEC)
2. National Electrical Manufacturer’s Association (NEMA).
3. American National Safety Institute (ANSI).
4. Underwriters Laboratories (UL)
5. American Society of Testing and Materials (ASTM)
6. Electronics Industries Association (E.I.A)
7. Davis and Davis, Sound System Engineering (3rd Edition), Howard W. Sams, 2006
8. Giddings, Audio System - Design and Installation, (ASDI) Howard W. Sams, 1990
9. ANSI/TIA/EIA-568-A-Commercial Building Telecommunications Cabling Standard. (October 1995).
10. Building Industry Consulting Service International (BICSI).ANSI S4.48-1992

1.3 RESPONSIBILITY AND RELATED WORK

A. Electrical
1. The contractor shall be responsible for procurement and termination of new panel board(s) and distribution of electrical power from the panel to the equipment rack distribution as required. Each circuit extended from the panel is to have separate neutral and ground conductors. Power for this equipment to be served from the emergency power system to support emergency messaging in the event of a power failure.
2. A ground point will be provided in each equipment room or enclosure electrical panel. The contractor shall be responsible for connecting ground point to all equipment in accordance with NEC Code, local codes and standards specified herein. Isolated ground system is not required for this work.

3. The contractor shall be responsible for all additional conduit and raceway required at the catwalk level for the installation of the new loudspeaker system cabling from the racks to array locations. Reuse of existing conduit and raceway is acceptable if the existing locations are suitable for the new array positions. All conduits and raceway to be installed in accordance with NEC, local codes and standards specified herein.
4. The contractor shall be responsible for fire-stopping building penetrations associated with this Work. Fire-stopping to be installed in accordance with NEC, local codes and standards specified herein.

B. Structural
1. The contractor shall be responsible for design and structural engineering for all loudspeaker brackets attaching the loudspeakers (and / or loudspeaker hoisting system) to the building structure at position shown within the drawings.

1.4 SYSTEM DESCRIPTION AND REQUIREMENTS

A. The following is intended to provide an overview of the design concepts and is not an exhaustive description of the Sound System. Contractor to verify all as-built drawings from previous integration and any field conditions as they pertain to the renovation of the audio system. It is the responsibility of this Contractor to review as-built documents from original installation for additional information.

B. The project replaces the current seating bowl speaker systems and updates the mixing console, audio distribution and control equipment. The contractor is responsible for a complete and functioning sound system as described herein.

C. The contractor is required to document current inputs, outputs and audio interfaces to the system and to restore existing functions for sound reinforcement, paging and audio distribution. The removal of all existing equipment is part of this Work. This includes all loudspeakers and rigging associated with the existing bowl loudspeaker system, amplification equipment and processing, abandoned cabling, and control equipment not being reused. This decommissioned equipment is to be inventoried, palletized for Owner and moved to a location as directed by the Owner. Any rack space not being reused is to be removed or filled with blank panels to facilitate proper cooling of adjacent racks.

D. Ethernet Network:
1. The Audio System components will communicate electronically by means of a dedicated IEEE 802.3 Ethernet compliant Local Area Network (“LAN”). An IEEE 802.3 Ethernet compliant LAN will be dedicated for audio system network communication as part of this Work. The LAN will consist of managed network edge and core switches.
2. The LAN cabling infrastructure (“Structured Cabling”) Horizontal Cabling is provided to each edge device, such as amplifiers, digital audio signal processors, computers, and other intelligent remote devices by cabling specified as part of this Work. The backbone fiber optic cabling from the control room to amplifier rack location is also part of this Work. The contractor is responsible to verify network hardware and software configuration with Digital Signal Processing and Amplifier network product manufacturer for optimum reliable performance.
3. All Ethernet devices shall be compliant with University standards and practices.

E. Audio Control:
1. The audio control equipment is located in the bowl control booth. Dedicated racks within the booth house the patch panels, program sources, wireless microphone receivers, and processing.
2. The current analog mixing console is replaced and updated with a digital console. The mixer is connected to the patchbay racks by way of digital stagebox (A/D converter with

microphone preamps) and a dedicated Ethernet LAN. The patchbay is replaced with a programmable “TT” style. The patchbay is to be arranged in a logical and efficient manner and any unused patch points “blanked”.

3. Existing connection panels and microphone and line level cabling throughout building are to be tested and reused and will provide for direct connection to the system through multiple input receptacles and tielines. Inputs to the system to be maintained and accommodated by the system renovation project include Arena connection box inputs, Audio from Video Production, and paging microphones at Fire Control/Security.
4. Existing connection panels and cabling throughout the press box area and feeds to other destinations such as clubs, ticket offices, and elsewhere are intended to be tested and reused. Outputs to ancillary system to be maintained and accommodated include Paging system, Concourse speakers and Restroom speakers. The console I/O interface will be configured to send and receive multiple stereo pairs of digital audio signals routed to and from the video replay system in the control room. Any newly provided microphone and line level cabling will meet AES/EBU digital audio performance standards.
5. In addition, the digital audio processing system and the system control computer user station will be operated from the audio control booth location. The control computer CPU’s and associated network switches will be located in the equipment racks and operated from the audio control booth position.

F. Digital Audio Processing:
1. The digital audio processing system in the audio control booth provides audio signal processing and signal routing and then feeds digital audio signals and digital audio to the audio system equipment throughout the facility. The system will take digital/analog audio signals from various source equipment and auxiliary inputs on the patch panels and convert them to digital audio for distribution throughout the building.
2. An analog backup signal will simultaneously be routed over separate cabling to the amplifier rooms powering loudspeakers in the main seating bowl and in the event of a catastrophic network failure this backup signal will be automatically activated by digital audio processers or power amplifiers at each amplifier location.

G. Audio Amplification:
1. The sound system amplifiers and processors are located in standard equipment racks in a dedicated area within the catwalk level. The existing equipment rack may be re-used. The new amplifiers and signal processing for the primary bowl loudspeaker system is located with amplifiers driving the main bowl sound system. Signals for the digital audio processors will be supplied from the network digital feed and will then connect directly to each amplifier as a digital audio feed.
2. Each amplifier will have DSP processing and a control interface built in and will provide processing, control and monitoring of each amplifier from the audio control room as noted above. For additional inputs or outputs needed at a given amplifier location, the proprietary digital buss of the digital audio processing system may be used for signal distribution in conjunction with the appropriate input/output expansion device.

H. Seating Bowl Loudspeakers:
1. The seating bowl loudspeaker system is an exploded central cluster design with six main arrays of loudspeakers suspended from the building’s roof structure. Each array will have multi -pin disconnect(s) to allow arrays to be disconnected and lowered to floor level. Multi pin extensions will be provided to allow operation of the arrays at floor level for test and maintenance.
2. A cluster of loudspeakers mounted within the bottom of the scoreboard structure will provide additional sound coverage to the arena floor area. All rigging and attachment hardware, structural engineering, conduit and cabling to install these loudspeakers will be part of this Work. It is intended that all speaker cabling for the six main arrays and

scoreboard speakers to be installed new and any existing cabling no longer used to be removed.

I. Audio Backup Signal:
   1. An analog backup signal from the audio control booth will be distributed to each digital audio processor or power amplifier connected to the seating bowl loudspeakers. Each backup input will be setup to automatically switch to the analog backup signal in the event of failure or interruption of the digital feed or if the digital feed loses sync.

J. Fire Alarm Override:
   1. Verify the current system allows the fire alarm system to send the main seating bowl audio system warning signals and announcements from the main fire command center. These features are to be maintained with the new audio system. Field verify current conditions as these connections exist and are intended to be reused upon testing. The audio signal for this emergency override condition will insert into both the digital audio processing system and provide signal to the main digital distribution and analog backup.
   2. The emergency audio signal will be automatically routed to the system whether the standard digital audio transport or the analog backup is engaged. The switch over to the fire alarm signal will be by a contact closure received from the fire system connected to the digital audio processing system. During an emergency with the fire alarm, all systems other than those that cover the main seating bowl shall mute.

K. Assistive Listening System:
   1. This system is being replaced. Reference drawings and specifications for further details.

L. Press Area Systems:
   1. This system is currently in place and operative. Any audio feeds and digital control features associated with this system must be maintained.

M. Weight/Cardio Room
   1. This area is to include new speakers in locations as shown on the drawings.
   2. The sound system is to be capable of playing Back of House audio feeds provided by the audio control room but selected at the control panel.

N. Team Store:
   1. Existing system is to remain. Provide an analog signal to the existing mixer from the new audio distribution system.

O. Suites:
   1. Suites are to receive new speakers and volume controls.
   2. Suites are to be re-zoned per drawings.

P. Bowl Sound System Rigging:
   1. Provide loudspeaker hoisting system as a turnkey Design-Build element.
   2. Engineer and provide complete system using two chain motors for each array for raising and lowering the six main arrays and four subwoofer arrays. Provide structural engineering and installation of the loudspeaker rigging attachment points and any additional structure required. Coordination will be required between this contractor, the Owner and their structural engineer regarding the array weight and positions for these attachment points at structure.
   3. High storage position to hold bottom of arrays as close to elevation of bottom chord of roof steel as possible. Note elevation to bottom of arrays with proposal.

4. Hoisting system to hold loudspeaker arrays at normal operating position and also at preset elevations for storage and service. Preset stops to be programmable and initiate automatically.
5. Hoisting system to use entertainment industry standard CM Lodestar D8+ chain motors with 10:1 design safety factor, secondary and rated for suspending equipment overhead.
6. Rigging components/hardware, cabling, sheaves, attachments, etc. installed as part of this system to achieve 8:1 design safety factor.
7. Hoisting System to be provided with all necessary service and maintenance provided for two-year warranty.
8. Provide a wired control location at the Audio Control platform.
9. Standard of Quality Control System
    a. Motion Labs
    b. Approved Equivalent

1.5 QUALITY ASSURANCE

A. The Sound System Integrator shall be experienced in the provision of systems similar in complexity to those required for this project and meet the following requirements:
    1. The primary business of contractor shall be the provision of sound systems.
    2. No less than five years' experience with equipment and systems of the specified types.
    3. Demonstrate experience with at least two projects of this type comparable scale within the last four years involving large-scale reinforcement audio systems.
    4. Be a franchised dealer and service facility for the major products furnished.
    5. Maintain a fully staffed and equipped service facility with full time field technicians. It is recommended that the installation team members have following NICET or National Systems Contractors Association (NSCA) certifications.
    6. Project Manager: NICET Level III or R-ESI Integrator Certification.
    7. Field Supervisor: NICET Level II or C-EST Technician Certification.
    8. Crew Lead: NICET Level I or C-SI Installer Certification.
    9. At the request of the Owner, the Contractor shall demonstrate that he has:
        a. Adequate plant and equipment to complete the work
        b. Adequate staff with commensurate technical experience

B. Any other contractor who intends to bid this work as the prime contractor and does not meet the required qualifications shall employ the services of a single "Sound System Contractor" who does meet the requirements noted above and is approved by the Owner. This "Sound System Contractor" shall:
    1. Furnish the equipment.
    2. Shop fabricate the equipment racks and subassemblies.
    3. Make audio, speaker and control connections to equipment racks, each piece of equipment, and connection panels.
    4. Continuously supervise the installation and connections of cable and equipment.

C. Work shall be in compliance with the applicable standards listed above and all governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
    1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
    2. Where requirements between governing Codes and Regulations vary, the more restrictive provision shall apply.
    3. Nothing in the Contract Documents shall be construed as authority or permission to disregard or violate legal requirements.

D. Coordinate exact location and installation of equipment, power, conduit, and raceway systems with the Owner.

1.6 SUBMITTALS

A. Comply with the general terms and conditions–Project Submittal Procedures.

B. Supplementary submittal requirements:
1. Complete schedule of submittals.
2. Chronological schedule of Work in bar chart form
3. Provide a list of and manufacturer's data sheet on product to be incorporated within the Work. Organize data sheets in specification order.
4. Upload to project FTP site in PDF format.
5. Separate major product or specification grouping within separate folders. Each group to be bound as a single or packaged PDF file.
6. Functional diagrams and description of all parts of the system integration.
7. Shop Drawings:
8. Schematic: Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and cable designators, and device designators. Provide connector designations and terminal strip identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use this designator consistently throughout the project.
9. Coordination Drawings:
10. Prepare and submit a set of coordination drawings showing major elements, components, and devices of the sound system in relationship with other building components. Prepare drawings to an accurate scale of 1/8"=1'-0" or larger on suitable sized media.
11. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all equipment. Indicate locations where space is limited, and where sequencing and coordination of installations is of importance to the efficient flow of the work including but not necessarily limited to the following:
12. Equipment housings
13. Ceiling and wall mounted devices
14. Raceways
15. Cabling
16. Equipment housing: Location of equipment in racks, consoles position on tables or counters. Details to include dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations
17. Patch panel layouts and labeling strips, including color schemes.
18. Full fabrication details of custom enclosure and millwork indicating size, material, finish and openings required for equipment and enclosures.
19. Structural rigging and mounting details:
20. Structural rigging and mounting details of all loudspeakers suspended from or mounted to the building structure: These drawings will identify all types of hardware, fittings and materials to be used. Detail the product manufacture, part numbers and load capacity of the hardware, fittings and materials selected. All loudspeaker structural rigging and mounting detail drawings shall be signed and sealed by a professional engineer licensed to practice in the State of Arkansas and will include a copy of the design calculations.
21. The signed and sealed drawings noted above to include the following:
22. Attachment method to building structure for suspended loudspeakers or mounting brackets
23. Any secondary steel required for attachment to the building structure.
24. All fittings, hardware, materials, and cable used for suspended loudspeakers.
25. All custom brackets, mounts, suspension grids or trusses and loudspeaker cabinet frames or brackets not supplied by the manufacturer of the specific loudspeaker to be mounted or suspended.

26. Fabricated Plates and Panels: Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
27. Labeling: Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
28. Schedules: Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting and location. Include this information with remainder of wiring diagrams.

C. Submittal format:
1. Floor plan drawings executed at an appropriate scale, not less than 1/8” = 1’-0”.
2. Detail drawings executed at an appropriate scale, not less than 3/8” = 1’-0”.
3. Plate and panel drawings executed at an appropriate scale, not less than 1/2” = 1”.
4. Rack, enclosure, and millwork detail drawings executed at an appropriate scale, not less than 1” = 1’-0”.
5. Separate major grouping with labeled binder tabs.
6. Bind contents in titled three ring D style binders sized for 150 per cent of the material. Maximum size: three-inch spine. Use multiple volumes if necessary.
7. Additionally provide all submittal drawing and binder contents on finalized DVD media, FTP upload, or hardcopy as directly.
8. Any electronic documents to be in non-proprietary Adobe PDF format

1.7 PROJECT CLOSEOUT

A. Comply with the general terms and conditions–Project Closeout Procedures.

B. Supplementary Project Closeout Procedures
1. Provide all close-out documents on a finalized DVD media as well as bound hard copy. The DVD documents to be in non-proprietary “PDF” format.
2. Product Data: Product actually incorporated within the Work.
3. Manufacturer's data for each type of product conforming to the submission format specified herein. Include manufacturer’s serial numbers within the list of product.
4. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
5. Each products Owner/Instruction Manual. Provide high quality copies where necessary, with all text legible and illustrations of equal resolution and sharpness as the original manual. Faxed copies or copies with portions of the information missing or smeared not acceptable.
6. Manufacturer’s maintenance and care instructions.
7. Separately bound list by manufacturer and model or part number of product incorporated within the Work arranged in alphanumeric order. when applicable Manufacturer's warranty statements bound separately.
    a. Record drawings: Final rendition of Shop Drawings depicting what is actually incorporated within the Work. Provide Record Drawings in both PDF and AutoCAD “DWG” format.
8. Test Reports: Recorded findings of Contractor’s Commissioning.
9. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
10. Describe the operation of system capabilities.
11. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.
12. Service & Maintenance Manual:
    a. Provide an original manufacturer’s copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. On equipment where there is no service manual, provide statement from company indicating

manual is not available. Arrange manuals in the same order as the operations manual.

b. Manufacturer's maintenance and care instructions

c. Maintenance Instructions, including maintenance phone numbers and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.

13. Provide copies of all current versions of the software programs of the various system components on DVD or CDR. Include all site files for the system configuration and internal device settings.

14. Any other pertinent data generated during the Project or required for future service.

15. Segregate documents into separate bindings containing data relevant to operational, maintenance and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Owner's pre-existing speakers are to be handled carefully and turned over without damage.

B. To prevent damage or entrance of foreign matter, ship product in its original container

C. Ship in accordance with manufacturer's recommendations

D. Provide protective covering during integration.

E. At no expense to Owner, replace product damaged during storage or handling.

1.9 PROJECT CONDITIONS

A. Verify conditions on the job site applicable to this work. Notify Owner's Representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings show cables, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and submit drawings to the Owner for approval, showing how the work may be installed.

1.10 FINAL OBSERVATION AND TESTING

A. Upon completion of the installation and contractor commissioning as specified in Part 3, observation and testing shall be performed by the Owner and their consultant.

B. To assist the Owner, provide a minimum of one person for observation and two persons for testing who are familiar with all aspects of the system included programming and control of the DSP system.

C. The process of testing the System may necessitate moving and adjusting certain components such as speaker aiming or transformer taps.

D. Testing includes operation of each major system and any other components deemed necessary. Provide required test equipment, tools and materials required to make necessary repairs, corrections or adjustments.

E. The following procedures will be performed on each System by the Owner and their consultant:

1. Observation of the methods provided to incorporate the System within the facility.
2. Verification of proper operation of all devices.
3. Verification that the equipment has been properly adjusted, balanced, and aligned for optimum quality and meets the manufacturer's published specifications.
4. In the event further adjustment or work becomes evident during testing, the Contractor shall continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor shall pay for additional time and expenses of the Owner or his representative at the standard rate in effect at that time.

1.11 WARRANTY:

A. Contractor shall warrant equipment to be free of defects in materials and workmanship for two years following the date of the first regular season NCAA game, trouble free operation, or substantial completion, whichever is later.

B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics; repair or replace defects occurring in labor or materials within the Warranty period without charge.

C. The project requirements include local service and warranty by the current AV service and maintenance contractor:
   a. Within the Warranty period, answer service calls within two hours, and correct the problem within twenty four hours.

D. This warranty shall not void specific warranties issued by manufacturers for greater periods of time, nor shall it void any rights guaranteed to the Owner by law.

E. Installing contractor to provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Record Drawings

F. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment or transducers discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment. Coordinate inspection visit with the Owner.

1.12 INSTRUCTION OF OWNER PERSONNEL

A. After final completion, provide eight (8) hours of instruction to Owner designated personnel on the operation and maintenance of the System. If any component is not operational at the time of testing or training, the vendor shall return to complete the testing or training on the component.

B. Develop instructional course based on the use of the system and manufacturer’s recommendations. Arrange course so that operational and maintenance-training seminars are separate.

C. Training Submittals:
   1. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training.
   2. Following discussions with Owner, formally submit a Training and Event Attendance submittal two weeks prior to first training. Submittal shall:
   3. Include a separate page/entry for every training session.
   4. Indicate date, time, and approximate length of training session.

5. Indicate person(s) conducting training.
6. Indicate whether training will be video recorded.
7. Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
8. Include signature and title lines for:
9. Owner acknowledging and accepting training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
10. Countersigning by trainer indicating that training actually occurred.
11. All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
12. Owner's representative attending training at the end of the session shall initial that:
13. Training Occurred.
14. Training Materials were provided and left with Owner
15. Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
16. Training was generally sufficient for the proposed curriculum.
17. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.).
18. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.
19. Provide all training material on DVD in Adobe PDF format.

D. Sound system contractor shall have at least two persons present at the first EIGHT Events held in the bowl following substantial completion. An Event is considered a use of the bowl audio system when paid spectators occupy at least 50% of the bowl seating. The contractor shall be on site the day before the event in addition to the day of the event. These first eight events must include the first regular season games in the University of Arkansas schedule. Contractor staff at all events must be able to make adjustments within DSP system as well as being able to troubleshoot system components.

1.13 TECHNICAL SYSTEMS SOFTWARE LICENSE

A. Introduction:
1. All proprietary software provided for the Technical Systems shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
2. Contractor shall agree that 3rd party (e.g. manufacturer's) proprietary software provided with the system shall be subject to this agreement.
3. Contractor and owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties; and shall supersede any standard manufacturer or Contractor's standard license agreement.
4. Proprietary software shall be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.
5. For sake of this agreement, MS Windows® shall not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.

B. License Grant and Ownership

1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the owner.
2. Except as expressly set forth in this paragraph, the Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of owner.
3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.

C. Copies, Modification and Use
1. Source code shall be available to owner for a period of not less than 15 years.
2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of owner and its representatives.
3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right in owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.
5. During the life of the system (defined as a period of not less than 10 years and not more than 15 years), the Contractor shall provide software updates in accordance with all necessary support requirements to maintain the system. This shall include a commitment to provide appropriate patches, fixes, and interface updates as necessary to maintain the operability and security of the system at a level commensurate with the original system.
6. In the event that computer and or processor hardware refinements and updates are necessary to support software updates 7 years after substantial completion, said hardware will be provided to owner at the agreed upon terms for change orders of the original contract.
7. Labor shall be in accordance with change order rates of the original contract, as adjusted for inflation in accordance with conditions and limitations of the general contractor or U.S. Bureau of Labor Statistics' Consumer Price Index (CPI).
8. All hardware supplied shall support software updates for a period of not less than 7 years following substantial completion.

D. Warranties and Representations
1. Contractor represents and warrants to Owner that:
2. It has all necessary rights and authority to execute and deliver this Software License and perform its obligations hereunder and to grant the rights granted under this Software License to owner.
3. The goods and services provided by contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners.

4. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
5. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.

E. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third party intellectual property rights.

1.14 ADDITIVE OPTIONS

A. Bowl Sound System Delay Speakers
1. Provide separate bid breakout for bowl sound system delay speakers.
2. To include Speakers, Mounting, Cabling, Amplifiers, and DSP.

B. Intercom
1. Test, Repair/Refurbish all intercom equipment, cabling and connections.

C. Service Contract
1. Provide proposal for service contract of 2-5 years consummate with the complexity of designed system.

PART 2 EQUIPMENT

2.1 ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed as a standard of function, performance and quality.

B. Refer to Project General Conditions for equipment substitute procedure.

2.2 GENERAL

A. Product quantity is as required. If a quantity is given, Sound System Contractor shall provide at least the given amount. Some product listed under this section may not be required to fulfill the obligations of the work.

B. Equipment and materials shall be new and conform to applicable UL or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.

C. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet published manufacturer's specifications.

D. Audio XLR type connectors not a part of manufactured equipment shall have gold plated contacts. This includes all cable mounted connectors as well as chassis mounted connectors on custom fabricated panels.

E. Remove all manufacturers' names, logos, or other symbols from speakers or other objects placed in view of the public. If logo badge does not allow for removal paint badge to match the color of the loudspeaker grill or other loudspeaker cabinet finish.

F. All loudspeaker finishes are to be factory applied. Ceiling and wall mounted speaker grilles and enclosures to match the surrounding ceiling or wall color as directed by Owner.

2.3 MICROPHONES AND ACCESSORIES

A. Wireless Microphone Receiver System (WIR MIC):
1. Receiver Type: Digital Wireless System with automatic switching diversity reception with XLR type audio output connectors.
2. Indicators: LED signal strength meters for battery, RF and audio levels.
3. Frequency: Coordinate with FCC and local requirements.
4. Antennas: Rear mount passive antennas for the frequency spectrum chosen.
5. 1-RU Rack mountable.
6. Acceptable product to include:
   a. Shure: ULXD4Q Diversity Receiver
   b. Shure: SBC200-US Battery Charger Base (WIR CHRG)
   c. Shure: SB900 Lithium Ion Battery (Qty. 4)
   d. Shure: ULXD2/58 Handheld Transmitter (Qty. 4)
   e. Shure: ULXD1 Bodypack Transmitter (Qty. 4)
   f. Shure: WL185 Cardioid Lavalier Microphone (Qty. 4)
   g. Shure: WH20TQG Dynamic Headset Microphone (Qty. 4)
   h. Shure: RK318WS Replacement Windscreens (Qty. 10)
   i. Shure: RK319 Replacement Black Elastic Headband (Qty. 4)
   j. Shure: Antenna System.
      1) Shure HA-8089
      2) Provide with mounting hardware to mount to antenna bar outside of control room area.
      3) Shure Wireless Workbench 6 Software Package.

2.4 INPUT SOURCES

A. Compact Disc Player (CD):
1. Outputs to be balanced XLR type connectors capable of +4 dBm level into 600 Ohm load
2. Player to include remote transport control
3. Player to be network controllable from PC
4. Player to be single disc slot type
5. AES digital output capability
6. 1-RU Rack mountable
7. Acceptable product:
   a. Denon DN-700C
   b. Approved Equivalent

B. Digital Media Player (DM PLAY/REC):
1. Outputs to be balanced XLR type connectors capable of +4 dBm level into 600 Ohm load
2. Player to include remote transport control
3. Player to be network controllable from PC
4. Player to include USB & SD Card capability
5. AES digital output capability
6. Network interface to allow for playback of digital music files stored on remote computer or hard disk.
7. 1-RU Rack mountable
8. Acceptable product:
   a. Denon DN-700R
   b. Approved Equivalent

C. USB Sound Card (USB SOUND):
   1. Minimum 8 channel output
   2. Balanced mic/line input with pre-amp
   3. Minimum USB 2.0 connection
   4. 1 RU Rack mountable
   5. Acceptable products:
      a. MOTU 828mk3 Hybrid
      b. Focusrite Scarlet 18i20
      c. PreSonus AudioBox 1818VSL
      d. Approved Equivalent

D. HD Radio Tuner (AMFM):
   1. HD radio reception capable
   2. RF Tuning Range:
      a. AM: 520kHz to 1720kHz in 10kHz increments
      b. FM: 87.9MHz to 108.1MHz in 200kHz increments
   3. RF Useable Sensitivity:
      a. AM: 5dBf (0.9µV) 20dB SNR at 30% modulation
      b. FM: 5dBf (0.9µV) 30dB SNR at 100% modulation
   4. RF Useable Input Range: 15µV to 30KµV, AM or FM
   5. IF Rejection:
      a. AM: Greater than 100dB for 20dB SNR
      b. FM: Greater than 100dB for 30dB SNR
   6. AF Bandwidth:
      a. AM: + 1dB 40Hz to 15kHz
      b. FM: + 1dB 20Hz to 20kHz
   7. AF THD+N: < 0.005% (digital audio)
   8. Stereo Channel Separation: > 90dB (digital audio)
   9. Provide antenna and all antenna distribution hardware, band separator, power supply and cabling required
   10. Acceptable product to include the following:
      a. DaySequerra M4.2S
      b. Pixel Model AFHD-1 Antenna Kit System

2.5 CONSOLES AND MIXERS

A. Digital Audio Mixing Console (MIX SURFACE):
   1. Frequency response: +0.5, -1.5 dB, 20 Hz to 20 kHz @ +4dBu into 600Ω
   2. Hum & Noise generation: -128 dBu (equivalent input)
   3. Input configuration: 3kΩ input, XLR-3-31 type (electronically balanced)
   4. Input Module: 16-channel mix buss, 8-channel matrix buses selection
   5. Three Mini-YGDAI Expansion Card Slots
   6. Built-in USB Memory Recorder/Player
   7. Dante digital networked audio over Ethernet
   8. Touch screen LCD
   9. Digital Section: 2TR Out AES/EBU
   10. Provide with fitted dustcover.
   11. Acceptable product:
      a. Midas M32 console with:
         1) Midas DN32-DANTE expansion card
      b. Yamaha CL3 console with:
         1) Yamaha MY16-AE 16 Channel AES/EBU I/O Card (Quantity: 1)
         2) Yamaha MY16-MD64 16 Channel MADI Interface Card (Quantity: 1)
         3) Yamaha LA1L LED Gooseneck lamp (Quantity: 2)
      c. Approved Equivalent

B. Digital Console Expansion I/O (MIX ENGINE):
   1. Inputs: 32 analog.
   2. Outputs: 24 analog, 4 AES/EBU Digital
   3. Network: Dante enabled.
   4. Phantom Power: +48V.
   5. Cross talk: -100dB @ 1k, minimum gain.
   6. Dynamic Range: 108 dB
   7. Rack mountable in 5 RU.
   8. Head amps controllable from the Yamaha console control surface.
   9. Acceptable Products:
      a. Midas DL16/DL32
      b. Yamaha Rio3224-D
      c. Approved Equivalent

2.6 CONTROL PC / EFFECT PC

A. The DSP system and control software shall be operational 30 days prior to the first use of the installed system.

B. Signal processing shall be performed by computer-based system. The DSP control platform is to incorporate amplifier and loudspeaker control, monitoring and configurable DSP.

C. The system shall have the following minimum capabilities:
   1. CPU: 3.1 GHz Intel® Core i5 processor (or more current processor).
   2. Operating System: Microsoft Windows 7 Professional, 64-bit.
   3. Enclosure/Case: 2-RU Rack Mountable.
   4. Power supply: 400 watt.
   5. Memory: 8 GB, DDR3 1333MHz.
   6. Internal Hard Disk 1: 500 GB. 7200RPM, SATA
   7. Internal Hard Disk 2: 500 GB. 7200RPM, SATA, fully redundant, mirrored, RAID 1.
   8. Networking: Dual 10/100/1000 Mbps.
   9. DVD+/-RW: Minimum of 16x recording speed. Include disc-recording software.
   10. Video: Intel HD Graphics with VGA and DVI outputs.
   11. Keyboard/Mouse
   12. Monitor: minimum 17” diagonal with desk stand
   13. Software to be included:
      a. License all software to the Owner.
      b. Norton Antivirus.
   14. Warranty: Three-Year Onsite Warranty with 24/7 Phone and Next Business Day Service.
   15. Computer system shall be completely tested by manufacturer prior to delivery.
   16. Quantity: Provide TWO identically configured computers with the second setup, as backup should the main CPU fail.
   17. Acceptable product:
      a. Super Logics SL-2U-LLQ67-DB (custom configured as above).

D. Keyboard Mouse Video (KVM):
   1. 1 RU height
   2. Minimum screen resolution 1280x1024
   3. Minimum 105 Key Keyboard
   4. Integrated touchpad
   5. Acceptable Product:
      a. Middle Atlantic RM-KB-LCD17
      b. Approved Equivalent

2.7 DSP SOFTWARE SETUP:

A. Provide site specific configuration of the DSP software.

B. Coordinate user interface, software functionality, and menu screens with Operator's Consultant.

C. Provide ongoing software upgrades and maintenance for 12 months from date of final acceptance.

D. Provide the following software control screens for both the rack operation position and wall mounted touchscreen. Software control screens to be configured for the following systems and functionality:
   1. Arena Seating Bowl:
   2. System to provide for delivery of game related announcements, music and video accompaniment and associated programming to spectators in the seats.
   3. System to permit individual spectral and temporal adjustment of similar speaker groups to synchronize the sound from the different speaker locations.
   4. System to permit selected portions of the speakers to be linked to the temporary reinforcement system for supplemental delay fill. In this mode the selected speakers will be signal aligned with the temporary system and saved as a recallable preset.
   5. System to permit logical portion of the seating areas to be adjusted separately from other areas for maintenance and operational considerations. Provide as graphical overlay on seating chart. Coordinate these mute zones with the Owner.
   6. Global: Full system mute. Overlay on full arena seating chart.
   7. Independent: Provide master mute per array, per each delay speaker, and for scoreboard speakers. Overlay on full arena seating chart.
   8. System to permit preset reconfigurations of the bowl system for use during other different sporting and stage events. System to use eight presets to allow rapid setup of standard configurations.
   9. Priority Page:
      a. Provide custom user interface panel and DSP configuration to replicate functions of current paging matrix.
   10. To supplement the building fire alarm, the seating bowl system shall be able to accept an audio and control signal from the alarm system.
   11. Upon activation of the control signal, normal audio to all areas outside the seating bowl to be muted.
   12. The seating bowl system shall switch from the normal audio program to the special audio signal provided by the alarm system.
   13. The sound system to remain in this state until the control signal is restored to its normal state.
   14. While in the priority mode, an indicator light in the audio control room should provide a distinctive indication that normal programming has been overridden.

2.8 DIGITAL AUDIO PROCESSING TYPE 1 (DSP 1)

A. Primary audio signal processing shall be performed by a networked system of digitally controlled processing units. Each unit shall be capable of operating independently or in groups.

B. The system shall have the following capabilities:
   1. The unit shall include an architecture based on an integrated floating point DSP engine with at least three internal DSP processing chips.
   2. The unit shall operate with a common digital audio bus with support for at least 64 simultaneous high-speed digital audio channels.

3. The digital audio bus shall include an external expansion port that supports bus-level connectivity for additional units.
4. The unit shall include software-based configuration and control through a Windows-based software application, with additional tools for creating user interface clients and integration with control systems.
5. The unit shall include modular input/output card bay system for support of individual 4 audio cards.
    a. The unit shall include a Dante audio transport module with support for at least 64 20-bit digital audio channels.
6. The unit shall be fan cooled.
7. The unit shall include integrated GPIO user configurable ports.
8. Acceptable product:
    a. BSS London BLU-806, BLU-326, BLU-120
    b. QSC Q-SYS 1100, IO Frame, IO Frame 8s
    c. Symetrix Edge

C. DSP Analog Input Card:
1. Input Signal Type: Analog microphone or line level.
2. Digital to analog converters shall be 24 bit.
3. Card shall support software control of analog functions including sensitivity, gain, and phantom power.
4. Euro style screw terminal connector blocks.
5. Acceptable product:
    a. BSS BLUCARD-IN
    b. QSC CIML4

D. DSP Digital Input Card:
1. Input Signal Type: Digital line level.
2. Card shall support software control of analog functions including sensitivity, gain, and phantom power.
3. Euro style screw terminal connector blocks.
4. Acceptable product:
    a. BSS BLUDIGITAL-IN
    b. QSC CAES4

E. DSP Analog Output Card:
1. Support for 4-8 Analog line level output channels.
2. Digital to analog converters shall be 24 bit.
3. Card shall support software control of analog functions including gain.
4. Euro style screw terminal connector blocks.
5. Acceptable product:
    a. BSS BLUCARD-OUT
    b. QSC COL4

F. DSP Digital Output Card:
1. Support for 4-8 Digital line level output channels.
2. Card shall support software control of analog functions including gain.
3. Euro style screw terminal connector blocks.
4. Acceptable product:
    a. BSS BLUDIGITAL-OUT
    b. QSC CAES4

G. DSP Audio Bridge (DAP-I/O):
1. The unit shall include modular input/output card bay system for support of individual 4-channel audio cards.

2. The unit shall include a modular Dante audio transport module with support for at least 64 20-bit digital audio channels.
3. The unit shall include an integrated GPIO breakout system with at least 16 configurable logic ports and 4 configurable high-current ports.
4. Front panel signal level indication for each input.
5. Unit to support microphone or line level inputs remotely selectable through control system.
6. Provide quantity of units to meet I/O requirements detailed on the drawings.
7. Acceptable product:
   a. BSS BLU-326
   b. QSC IO Frame

H. DSP Audio Bridge Input Card:
1. Support for 4 microphone or line level channels.
2. Analog to digital converters shall be 24 bit.
3. Card shall support software control of analog functions including sensitivity, gain, and phantom power.
4. Acceptable product:
   a. BSS BLUCARD-IN
   b. QSC CIML4

I. DSP Audio Bridge Output Card:
1. Support for 4 line level output channels
2. Digital to analog converters shall be 24 bit
3. Card shall support software control of analog functions including gain
4. Acceptable product:
   a. BSS BLUCARD-OUT
   b. QSC COL4

J. DSP Control Panel (CP):
1. 2 Gang controller
2. Power over Ethernet
3. Minimum of Volume and Source selection
4. Acceptable Product:
   a. BSS EC-8BV
   b. QSC TSC-3
   c. Approved Equivalent

K. Mono Summing Amplifier (MONO SUM):
1. Configuration: 2 input, 1 outputs with individual level adjustments
2. Input: electronically balanced with maximum input level of +18 dBv
3. Output: electronically balanced with maximum output level of +4 dBv into 600 Ohm load
4. 1-RU Rack mountable
5. Acceptable product to include:
   a. ATI SUM100 for balanced inputs
   b. ATI SUM100-RCA for unbalanced inputs
   c. Approved Equivalent

L. Audio Distribution Amplifier (DIST AMP):
1. Provide quantity of distribution amplifiers to meet the input/output configuration shown on the drawings
2. Configuration: 1x8, or 1x16
3. Output: +24dBm into 600 ohm balanced loads

4. THD: .001% typical, 20 Hz to 20 kHz
5. Response: +/-.25dB, 30 Hz to 20 kHz
6. Noise: -100dBm EIN 20 Hz to 20 kHz
7. Gain: 20dB maximum; each output has 40dB smooth adjustment range going to full off.
8. Output Impedance: 400 ohms balanced, 200 ohms single-ended, split and RF bypassed, AC coupled
9. Inputs: 30 kohm active balanced, split and RF bypassed; +22dBm maximum input level
10. 1-RU rack mountable
11. Acceptable product:
    a. ATI DA416S
    b. Approved Equivalent

2.9 AMPLIFIERS

A. Power Amplifiers:
1. Four channel power amplifier with the EIA standard RS-490 power rating at 1% THD into 70-Volt and 100-Volt constant voltage load or 8 ohm load as applicable.
2. Provide protection of circuit components in the event of input over-drive, output overload, or short circuits.
3. Frequency response: ±1 dB, 20 Hz to 20 kHz with less than 1 per cent THD at rated output.
4. Input impedance: 10 kohm balanced.
5. Output regulation: 2 dB from no load to full load conditions.
6. Noise generation: at least 85 dB below rated output with input shorted.
7. Provide one spare Type 1 amplifier.
8. Acceptable products:
    a. Amplifier: Type 1
        1) Crown DCi 8|600N, DCi 4|600N
        2) Powersoft Occtonali 4K4
        3) Lab.Gruppen C28:4
    b. Amplifier: Type 2
        1) Crown DCi 4|1250
        2) Powersoft M50Q
        3) Lab.Gruppen C:48:4
    c. Amplifier: Type 3
        1) Crown I-Tech 3x3500HD
        2) Lab.Gruppen D200:4

2.10 OUTPUT DEVICES

A. In Ear Monitors (IEM TX):
1. 72 MHz wide tuning range.
2. Networkable control from PC & Wireless Workbench.
3. Balanced audio outputs.
4. Switchable output power mW.
5. Approved product:
    a. Shure PSM-1000 and the following:
        1) Shure SB900 Battery (Quantity 4)
        2) Shure PA421A antenna combiner (IEM DIST)

2.11 ASSISTIVE LISTENING SYSTEM

A. General:
1. Purpose: provide radio frequency transmission of locally selected audio program to patrons in venue with wireless receiver

2. Coordinate frequencies of transmitters with other users in the area to avoid conflicts
3. Comply with current ADA Standards

B. Transmitter (ALT TRANSMITTER):
1. Configuration: Single-channel
2. Frequency: 72 MHz
3. Audio Input: Balanced, microphone or line level, 3-pin XLR
4. Provide power supply
5. Provide 1-RU rack mount bracket
6. Acceptable product:
a. Listen LS-58-072 to include the following
1) LT-800-072-01
2) LA-122 (ALT ANTENNA)
3) LA-326
4) LR-5200-072
5) LA-401
6) LA-430
7) LPT-A107-B
8) LA-381-01
9) LA-304

C. Receivers:
1. Configuration: Single channel
2. Frequency: 72 MHz
3. Frequency agile to adjust various systems
4. Programmable display
5. Include Lithium-ion rechargeable batteries for each unit
6. Include 12 spare battery packs
7. Receivers to be frequency adjustable for use in all venues
8. Acceptable product to include the following:
a. Listen LR-5200-072 (Qty. 25)

2.12 CONTROL SOFTWARE AND PROGRAMMING:

A. Provide latest version of interface software for user computer control system.

B. Provide network analysis and configuration software to setup and control Network components.

C. Provide 12 months of on-site software upgrades from date of final acceptance.

D. This project requires that the site specific software configuration shall be provided by a firm specializing in the engineering, programming and commissioning of large-scale computer controlled systems. The software is to be configured to support the new seating bowl loudspeaker system as shown on project drawings. Owner's pre-existing DSP system functions serving ancillary audio systems are to be integrated and replicated in the new DSP configuration.

E. DSP Software Setup:
1. Provide site specific configuration of the DSP software for the seating bowl sound reinforcement system and ancillary system feeds.
2. Coordinate user interface, software functionality, and menu screens with Operator's Consultant.
3. Provide ongoing software upgrades and maintenance for 12 months from date of final acceptance.

4. Software to be configured for the following systems:
5. Main Seating Bowl:
6. Provide equalization for main clusters.
7. Provide loudspeaker processing configuration for testing and tuning as follows:
8. Individual output control.
9. Group output by array
10. Group output by speaker type, Mains, floor, and scoreboard
11. Provide override interface for fire alarm audio announcements to the main bowl. Upon the completion of alarm override, system to revert to previous operating mode and configuration
12. Provide for preset system configurations for the various types of events.
13. Fire Priority Page:
    a. To supplement the building fire alarm, the seating bowl system will be able to accept an audio and control signal from the alarm system.
    b. Upon activation of the control signal, normal audio to all areas outside the seating bowl to be muted.
    c. The seating bowl system will switch from the normal audio program to the special audio signal provided by the alarm system.
    d. The sound system is to remain in this state until the control signal is restored to its normal state. Once the control signal has returned to its normal state the sound system is to return to its previous configuration.
    e. While in the priority mode, an indicator light at the audio control platform provides a distinctive indication that normal programming has been overridden.
14. Provide copies of software configuration to control system contractor to permit control system to interface with DSP unit. Make revisions as necessary to configuration file to facilitate control system integration.
15. Acceptable software platforms:
    a. Harman HiQnet Audio Architect
    b. QSC Q-Sys
    c. SymNet Composer

F. Amplifier Control System Setup:
1. Control System Makeup:
    a. All amplifier types shall be under computer control.
2. Control System shall use a minimum Windows 7 based software system.
3. Graphical displays and menu screens to maintain a consistent user interface
4. Screen selections shall be implemented by mouse pointer or keyboard.
5. System shall be implemented from control computer described above.
6. Control System shall communicate with other components via non-proprietary communication protocol. Provide all necessary repeaters, signal conditioners, format converters, etc. needed to connect the audio control room with the amplifier rooms. Data cable not to be run with audio cables.
7. Control System software shall include password protection for multiple user levels.
8. Control System Setup Functions:
    a. Amplifier setup and adjustment
    b. Each amplifier shall be individually adjustable and adjustable in preprogrammed groups from control screen on computer. When used in groups, amplifiers shall maintain their own relative gain levels.
    c. Provide loudspeaker processing configuration for testing and tuning as follows:
    d. Individual output control.
    e. Group output by speaker type and arena quadrant
    f. Group output by speaker type
    g. Controls shall include volume up/down in 1/2 dB increments and provide mute on/off, power, signal polarity, and peak voltage limiting.

h. Internal digital signal processing will provide for narrow band parametric equalization, asymmetrical equalization filters, delay, crossover, custom FIR filters provided by loudspeakers manufacturers, limiting and dynamics.

9. System shall permit both channels to be linked for common operation or separated for individual adjustment.
10. Provide ability to include user provided amplifier labels for identifying which unit is being controlled.
11. System shall provide for power on and power off of amplifiers.
12. Amplifier control screens shall include graphical indications of input and output levels, power status, reserve headroom and thermal conditions of amplifier.
13. System shall have easy access to pre-set amplifier configurations.
14. Each amplifier to be able to retain its current gain settings in the event of power outage or loss of communication with the control computer
15. Other system Capabilities:
16. Amplifier diagnostics and error reporting
17. Control system shall monitor operating parameters of each amplifier.
18. System shall alert operator when an amplifier or group of amplifiers is clipping or overheating.
19. System to indicate the relative impedance of the speaker line and alert the operator when the load on the amplifier has changed significantly
20. Provide user adjustability for amplifier alert by permitting operator to set degree of clipping or overheating before generating an alert.
21. Provide user selection on how alerts and errors are indicated, including any combination of: log file, printer, visual indicator, or audible indicator.
22. Visual system monitoring:
23. Provide for multiple bar graph displays of amplifier outputs on system monitor.
24. Size of graph and quantity displayed to be determined by operator.
25. Each graph shall indicate amplifier level in dB and include user provided label for describing amplifier function.
26. Graph shall also include information on amplifier clipping, reserve headroom, polarity, and mute status.
27. Provide integration of monitoring into DAP software platform.
28. System shall remain fully operable if one or more amplifiers ceases operation or goes off line.
29. System shall remain fully operable if the control system goes off line.
30. Software to run stand-alone with monitoring functions integrated into the main DSP control software.
31. Acceptable software platforms:
    a. Harman Audio Architect
    b. Lab Gruppen Controller Software
    c. PowerSoft Armonia

2.13 ETHERNET NETWORK AND INTERCONNECT

A. Network Overview:
1. Provide an 1,000 Mb based Ethernet structured cabling system to link the DSP and Digital to Analog Converters at the control platform and Amplifier Room.
2. Network to be a fully switched system using redundant links between nodes for increased bandwidth and reliability. Requirements will vary based on the DSP system selected for installation.
3. Network to be expandable to permit extension to other points in the facility or other locations within the facility
4. Provide 100% additional dark fiber for future expansion between AV Control and amplifier rack locations. All fiber strands, both active and spare to terminate through a rack mounted interconnect center.

a. Provision of Ethernet switch hardware, installation and configuration is by this Contractor. This Contractor is to employ or retain a Certified Network Associate to provide for the setup and commissioning of network including, but not limited to, VLAN's, QoS, and layer 3 routing.

5. Network selection and configuration to be compliant with University of Arkansas standards.

B. Ethernet Switches to support Catwalk Audio distribution (NETWORK SWITCH)
   1. Switch
      a. Juniper EX3300

C. LC Fiber Patch Cords:
   1. Type: Single-mode patch cable.
   2. Connector: LC Duplex – LC Duplex - UPC.
   3. Fiber: Single-mode.
   4. Length: 2m.
   5. Acceptable Product:
      a. Belden AX200507.

D. Rack Mount Fiber Interconnect Center:
   1. Provided for termination of all active and spare fiber strands
   2. Unit to have sliding tray for access to adapters and connectors
   3. Unit to rack mount
   4. Unit to have front labeling panel for cable identification
   5. 1-RU rack mountable
   6. Provide quantity as needed for fiber counts in each rack.
   7. Acceptable product to include the following:
      a. Siemon FCP3-RACK rack frame.
      b. Siemon RIC-F-LC12-01 Duplex LC Adapter Plates

E. RJ-45 Patch Cords:
   1. Provided for interconnecting Ethernet segments within equipment racks
   2. Cables to be factory made with flexible boot over connector.
   3. Provide an assortment of cable jacket colors to aid in wire tracing. Provide equal quantities of red, green, blue and yellow jacketed cables.
   4. Cables to be rated Category 6.
   5. Acceptable product:
      a. Siemon M6A-(XX)-(XX)

2.14 POWER CONDITIONING

A. Uninterruptable Power Supply (UPS):
   1. Provide UPS systems to maintain power to all computer CPU's and associated video monitors.
   2. Provide UPS system for all Digital Audio Signal Processing (DAP) units.
   3. UPS's shall be on-line style with sufficient battery reserve to operate for 15 minutes. Size each UPS unit for 25% additional capacity.
   4. 2-RU Rack mountable.
   5. Acceptable product:
      a. APC Smart-UPS 2200 Series SUA2200RM2U
      b. Juice Goose XVRT-2200
      c. Surge-X SU-2000-Li

B. Power Protection (SURGE):
   1. Provide surge protection device to maintain clean power to the following equipment:

2. DSP analog to digital converters
3. Fiber Transport system components
4. All uninterruptable power supply units (except Surge-X SU-2000-Li)
5. Acceptable products:
    a. Surge-X SX-1120RT

C. Rack Mounted Power Strip (POWER DIST):
1. 20 Amp/2400 Watt rating
2. Front panel AC voltmeter
3. Spike and surge suppression with over-voltage shutdown
4. 1-U Rack Mountable
5. Acceptable product:
    a. Surge-X SX-AX20E
    b. Approved Equivalent

D. Multi-Circuit Rack Power Strips:
1. Provide in each rack to accommodate quantity of circuits required for rack equipment.
2. Listings: NRTL listed to UL 60950
3. Circuits: Maximum 12 per strip
4. Ground: Isolated, dedicated ground wires for each circuit
5. Outlets: 15A, 20A or 30A
6. Labels: Engraved markings for circuit identification
7. Acceptable product:
    a. Middle Atlantic Products PDW Series High-Capacity Custom Power Strips

2.15 LOUDSPEAKERS

A. Type 1 Speaker:
1. Configuration: 5,25-inch full range
2. Coverage pattern: 100° conical
3. Sensitivity: 89 dB at 1W/1M
4. Frequency operating range: 75 Hz to 24 kHz
5. 70.7V Taps at 60W / 30W / 15W / 7.5W
6. Provide all necessary mounting hardware, brackets, and tile supports
7. Paint grille to match surrounding surfaces at the direction of the architect
8. Acceptable Product:
    a. JBL Control 26CT
    b. Tannoy CMS 603 DC
    c. QSC AD-Ci5ST
    d. Approved Equivalent

B. Type 2 Speaker (Concourse):
1. Configuration: 10-inch 2-way loudspeaker
2. Sensitivity: 95 dB at 1W/1M
3. Frequency Response: 85 Hz to 18 kHz
4. Power: 400W Program
5. Nominal Impedance: 8 Ohms
6. Provide bracing and all required hardware to firmly secure mounting
7. Acceptable Product:
    a. JBL AC195
    b. EAW VFR109i
    c. QSC AD-S10T
    d. Approved Equivalent

C. Type 3 Speaker (Under Balcony):

1. Configuration: 6-inch Two-Way loudspeaker
2. Sensitivity: 94 dB at 1W/1M
3. Frequency Response: 90 Hz to 18 kHz, -10dB
4. Power: Full range, 300W Program
5. Nominal input impedance: 8 Ohms
6. Provide bracing and all required hardware to firmly secure mounting
7. Acceptable Product:
    a. JBL AC895
    b. EAW VF
    c. QSC AD-6T
    d. Approved Equivalent

D. Type 4 Speaker (Upper Bowl Delay):
1. Configuration: 15-inch Two-Way loudspeaker
2. Sensitivity: 98 dB at 1W/1M
3. Frequency Response (±3 dB): 43Hz - 18 kHz
4. Maximum Peak Output: 132 dB SPL, 1m
5. Nominal Impedance: 8 Ohms
6. Power Handling: 700W Program
7. Provide factory finish on speaker and bracket as directed by Architect.
8. Provide all necessary custom mounting hardware, brackets, supports and any secondary steel required to attach to building structure.
9. Acceptable product:
    a. JBL AM5212-66
    b. EAW MK5366i
    c. Approved Equivalent

E. Type 5 Speaker: (Main Bowl Line Array)
1. Provide twelve array modules per array location.
2. Configuration: Three-way array cabinet.
3. HF: Three 1.5-inch exit driver, horn-loaded.
4. MF: Four 8-inch mid frequency transducers.
5. LF: Two 15-inch low frequency transducers.
6. Horizontal coverage pattern: 90°.
7. Frequency operating range: 35 Hz to 15 kHz.
8. Maximum SPL (Average):
    a. HF: 149.5 dB
    b. MF: 140.5 dB
    c. LF: 141 dB
9. Nominal impedance:
    a. HF: 8 ohms
    b. MF: 8ohms
    c. LF: 2x 8 ohms
10. Crossover: External active
11. Provide factory black finish on speaker and bracketing
12. Provide custom rigging truss, flybar modules and all necessary mounting hardware, brackets, supports and any secondary steel required to attach to building structure
13. Make speaker connection with Neutrik NL8 speakon or terminal strip
14. Acceptable product:
    a. JBL VTX V25-II
    b. Adamson Energia E15
    c. EAW KF740
    d. Approved Equivalent

F. Type 6 Speaker: (Main Bowl Subwoofer)
1. Provide four subwoofer speakers per array location

2. Configuration: Subwoofer Two 18-inch low frequency transducers
3. Frequency operating range: 24 Hz to 400 Hz
4. Sensitivity 1W/1M: 98 dB
5. Maximum SPL (Average): 144 dB
6. Nominal impedance: 2x 8Ohms
7. Crossover: External active.
8. Provide factory black finish on speaker and bracketing.
9. Provide rigging truss, flybar modules and all necessary mounting hardware, brackets, supports and any secondary steel required to attach to building structure
10. Make speaker connection with Neutrik NL4 speakon.
11. Acceptable product:
    a. JBL VTX S28
    b. Adamson Energia E218
    c. EAW SB1002
    d. Approved Equivalent

G. Powered Cue Monitors
1. Self powered bookshelf speaker
2. Minimum 5” Woofer, 1” Soft Dome Tweeter
3. Acceptable Product:
    a. JBL LSR308
    b. QSC K8
    c. Tannoy Reveal 502

2.16 SPEAKER HARDWARE AND SUPPORT STRUCTURE

A. Provide a modular loudspeaker hardware system as required to mount and suspend speakers in the arrangement as shown on the Drawings.

B. Attachment system to be supplied by vendor whose primary specialty is fabricating support systems for loudspeakers or similar devices over an audience

C. Provide safety cable on all bracket mounted loudspeakers.

D. Provide auxiliary support steel and hardware required to attach to building structure and design members to have a minimum safety factor of at least 7:1. Reference architectural and structural documentation for details on structural elements.

E. All wire rope used for loudspeaker suspension to have a minimum safety factor of 10:1.

F. Fabricate all components from powder coated steel.

G. Contractor is responsible for painting any welds associated with this Work. This includes bracket attachment points and welds required to attach bracketing to building structure, scoreboards or poles.

H. Acceptable manufacturer:
1. Approved Custom
2. ATM Flyware / Allen Products.
3. Polar Focus

I. Shoulder Type Machinery Eye Bolts:
1. Forged Steel – Shoulder, Quenched and Tempered.
2. Fatigue rated at 1-1/2 times the Working Load Limit at 20,000 cycles.

3. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
4. Select size of product based working load limits required.
5. Acceptable product:
   a. Crosby Group S-279 / M-279 Series.

J. Forged Eye Nuts:
1. Forged Steel – Quenched and Tempered.
2. Tapped with standard UNC class 2 threads after galvanizing.
3. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
4. Select size of product based working load limits required.
5. Acceptable product:
   a. Crosby Group G-400 Series.

K. Anchor Shackles:
1. Forged - Quenched and Tempered, with alloy pin.
2. Working Load Limit permanently shown on every shackle.
3. Hot Dip galvanized or Self-Colored.
4. Product to meet the performance requirements of Federal Specification RR-C-271D Type IVA, Grade A, Class1.
5. Select size of product based working load limits required.
6. Provide all screw pin type shackles with mouse wire.
7. Acceptable product:
   a. Crosby Group G-209 / S-209 Series Screw Pin.

L. Turnbuckles:
1. Acceptable turnbuckle assembly combinations include: Eye and Eye, Jaw and Jaw, Jaw and Eye.
2. End fittings are Quenched and Tempered, bodies heat treated by normalizing.
3. Hot Dip galvanized.
4. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
5. Product to meet the performance requirements of Federal Specifications FF-T-791b, Type 1 Form 1 - CLASS 4, and ASTM F-1145.
6. Select size of product based working load limits required.
7. All end fittings to be moused to the body with mousing cable.
8. Acceptable product:
   a. Eye and Eye:
      1) Crosby Group HG-226 Series.
   b. Jaw and Eye:
      1) Crosby Group HG-227 Series.
   c. Jaw and Jaw:
      1) Crosby Group HG-228 Series.

M. Swivel Hoist Ring:
1. All components are Alloy Steel - Quenched and Tempered.
2. Rated at 100% of Working Load Limit at 90° angle.
3. 360 swivel and 180 pivot action.
4. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
5. Bolt specification to be Grade 8 Alloy socket head cap screw to ASTM A 574.
6. Fatigue rated at 1-1/2 times the Working Load Limit at 20,000 cycles.
7. Zinc Plated (Yellow Chromate) finish for increased corrosion protection.
8. Select size of product based working load limits required.

9. Acceptable product:
    a. Crosby Group HR-125.

N. Wire Rope Thimble:
1. Product to meet the performance requirements of Federal Specification FF-T-276b Type II.
2. Hot Dip galvanized.
3. Select size of product based wire rope size required for suspended load.
4. Acceptable product:
    a. Crosby Group G-411 Series.

O. Wire Rope:
1. Strands: 7 x 19 Utility Cable.
2. Type: Galvanized.
3. Select size of product based working load limits required.
4. Acceptable product:
    a. Wire Rope Corporation of America (WRCA).

P. Wire Rope Sleeves:
1. Type: Copper Duplex.
2. Select size of product based wire rope size required for suspended load.
3. Acceptable product:
    a. Wire Rope Corporation of America (WRCA) SW-740 Series.

2.17 MISCELLANEOUS EQUIPMENT

A. Audio Equipment Racks:
1. Existing racks may be reused. Any new racks to be:
2. Type: Frame and panel with locking rear door.
3. Size: 32-inches deep with 44-45 units of vertical space.
4. Construction: Factory assembled 16-gauge cold-rolled steel frames with all corners welded.
5. Black enameled finish.
6. Provide all necessary side panels, trim pieces, tops, and blank panels.
7. Provide Middle Atlantic VBK-W27-W32 Vent Blocker kit(s) and configure for proper airflow and cooling of rack.
8. Acceptable product:
    a. Middle Atlantic Products BGR series

B. Rack Fan(s):
1. 10”, 115V.
2. Include mounting panel as required by selected rack configuration.
3. Include cord and hardware.
4. Acceptable products:
    a. Middle Atlantic FAN10 with GUARD-10.

C. Rack Fan(s) @ FOH Racks:
1. Insertable into rear doors of FOH Racks
2. 2 Reversible fan modules.
3. Acceptable products:
    a. Middle Atlantic KO-AWFP2
    b. Approved Equivalent

D. Fan Thermostat Control:
1. Switched 15A duplex outlet.

2. Temperature Range: 50 – 90 Degrees F°.
3. On and Stand-by LED indicators.
4. Integral mounting ears.
5. Provide for each rack and fan assembly.
6. Acceptable product:
   a. Middle Atlantic FC-4-1C.

E. Rack Temperature Display:
1. Provide one display in top front panel space of each amplifier rack.
2. Decora mount in 1-RU rack panel.
3. Digital readout in Fahrenheit or Celsius.
4. Acceptable products:
   a. Middle Atlantic TEMP-DEC with DECP-1X1 Panel.

F. Rack Blanks:
1. Flanged, aluminum panel.
2. Blank anodized finish.
3. Provide where shown on drawings.
4. Acceptable product:
   a. Middle Atlantic BL series.

G. Rack Drawer:
1. Drawer provided where shown on drawings.
2. Drawer depth to be 14.5 inches.
3. Acceptable product:
   a. Middle Atlantic D series.

H. Copper Bus Bars:
1. Material: Solid copper, 1/8 thick and 2-inches wide with threaded 10/32 holes.
2. Height: 70-inch for 40-RU or larger racks and 21-inch for racks under 40-RU.
3. Wire each circuit ground to bus bar and isolated outlet ground.
4. Terminate two #6 wires between rack and buss bar.
5. Provide with nylon isolation mounts.
6. Provide one bus bar in each rack.
7. Acceptable product:
   a. Middle Atlantic BB-40.
   b. Middle Atlantic BB-12.

I. Patch Panel – 96 Point (PATCHBAY):
1. Identification strips to be printed labels of different color for each major connector grouping. Use a combination of colored fonts on white background and black fonts on colored backgrounds.
2. Non-terminated inputs to be shorted through normalling contacts on rear panel.
3. Type: Longframe, two rows of 48 jacks Bantam TT style.
4. Termination: 18-28 AWG stranded, oversize split cylinder capable of two wires per terminal.
5. Labeling: Standard label strips and color-coded, numbering required for each terminal.
6. Programmable Normals.
7. Programmable Grounding
8. Tool: ADC punch tool gives clean 1-step wire insertion and trimming. Provide one tool and tip to owner.
9. Labeling: Circuit designation strip and title block.
10. 2-U Rack Mountable.
11. Acceptable product:
    a. Bittree B96DC-FNAIT/ID M2OU12B to include the following:

1) Bittree BPC1200-110 12” Black TT-TT (Quantity: 24)
2) Bittree BPC2402-110 24” Red TT-TT (Quantity: 24)
3) Bittree BPC3604-110 36” Yellow TT-TT (Quantity: 24)
4) Bittree BPC4805-110 48” Green TT-TT (Quantity: 12)
5) Bittree BPC6006-110 60” Blue TT-TT (Quantity: 12)
6) Bittree BPCXF7200-110 72” Black TT-XLRF (Quantity: 12)
7) Bittree BPCXM7202-110 72” Red TT-XLRM (Quantity: 12)

b. Approved Equivalent

J. Transformers:
1. Line Input and Bridging: Jensen JT-11SSP-6M.
2. Line Isolation: Jensen JT-11SSP-6M.
3. Microphone Bridging: Jensen JT-MB-C.
4. Microphone Matching: Jensen JT-MB-C.
5. Unbal-Bal: Jensen JT-10KD-B.

K. Loudspeaker Terminal Strips:
1. Type: Compression clamp.
2. Size: M 6/8.
3. Mounting: DIN Rail.
4. Color: Grey, Blue, and Orange.
5. Provide with ferrules.
6. Acceptable product:
   a. Entrelec M6/8.

L. Plugs:
1. Accepted product:
2. Type XLR-3MP:
3. Neutrik NC3MX-B.
4. Switchcraft AAA3MBAUZ.
5. Type XLR-3FP:
6. Neutrik NC3FX-B.
7. Switchcraft AAA3FBAUZ.
8. Type XLR-5MP:
9. Neutrik NC5MX-B.
10. Switchcraft AAA5MBAUZ.
11. Type XLR-5FP:
12. Neutrik NC5FX-B.
13. Switchcraft AAA5FBAUZ.
14. Type XLR-3MP Right Angle:
15. Neutrik NC3MRX-B.
16. Switchcraft R3MBAUZ.
17. Type XLR-3FP Right Angle:
18. Neutrik NC3FRX-B.
19. Switchcraft R3FBAUZ.
20. Type TRS:
21. Neutrik NP3X-B.
22. Type 1/4”:
23. Neutrik NP2X-B.
24. Type RCA:
25. Neutrik NF2C-B/2.
26. Switchcraft 3502ABAU.
27. Type Speakon:
28. Neutrik NL4FC (4-Cond).
29. Neutrik NL8FC (8-Cond).
30. Switchcraft HPCC4F (4-Cond).

31. Type BNC:
32. Kings. Verify part number with cable selected.
33. Trompeter. Verify part number with cable selected.
34. Type Fiber Optic Field Cable:
35. Neutrik OpticalCon NK-O2.
36. Type BNC for Work Clock:
37. Kings 2065-2-9.
38. ADC BNC-1.
39. Gepco BNC-XL-2.

M. Relay
1. Configuration: DPDT contacts.
2. Control from switch, button, or logic circuits.
3. Operate from 24 VDC
4. Acceptable product manufacturers:
   a. Magnecraft.
   b. Potter Brumfield.
   c. Radio Design Labs.

N. Solid-State Relay (SSR):
1. Configuration: 2 audio inputs, 1 audio output.
2. Silent audio switching.
3. Control from switch, button, or logic circuits.
4. Operate from 24 VDC.
5. Acceptable product manufacturers:
   a. Line Level: Radio Labs ST-SSR1.
   b. Microphone Level: Audio-Technica AT8684.

O. Loudspeaker Multipin Connectors:
1. Voltage rating: 240 VAC minimum.
2. Current rating: 30A @ 12 AWG.
3. Cable size accepted: 12 AWG or .193-inches maximum diameter.
4. Number of contacts: 19 and 42.
5. Provide In-line connectors with chained, removable covers and Kellum type strain relief.
6. Provide 20 spare male and female contacts and a crimp tool to the owner.
7. Acceptable product:
   a. Straight In-line Cable Plug 19-pin Female:
      1) Amphenol Industrial Star-Line ZPEKJ-20-16-312SN.
   b. Straight In-line Cable Plug 19-pin Male:
      1) Amphenol Industrial Star-Line ZPEKJ-20-16-312PN.
   c. Straight In-line Cable Plug 42-pin Female:
      1) Amphenol Industrial Star-Line ZPEKJ-28-28-339SN.
   d. Straight In-line Cable Plug 42-pin Male:
      1) Amphenol Industrial Star-Line ZPEKJ-28-28-339PN.
   e. Junction Box Mounted Receptacle 19-pin Female:
      1) Amphenol Industrial Star-Line ZRCBB-5-16-312SN.
   f. Junction Box Mounted Receptacle 42-pin Female:
      1) Amphenol Industrial Star-Line ZRCBB-7-28-339SN.

P. 19-Pin Speaker Extension Cable:
1. Length: 120 feet.
2. Conductors: 8 minimum.
3. Cable: Houston Wire and Cable HW250 01208 or TF Kable SOOW12-8.
4. Quantity: 1.

5. Provide a breakout price for owner to purchase additional cables.
6. Connectors:
   a. Straight In-line Cable Plug 19-pin Female:
      1) Amphenol Industrial Star-Line ZPEKJ-14-16-312SN.
   b. Straight In-line Cable Plug 19-pin Male:
      1) Amphenol Industrial Star-Line ZPEKJ-14-16-312PN.

Q. 42-Pin Speaker Extension Cable:
1. Length: 120 feet.
2. Conductors: 40 minimum.
3. Cable: Houston Wire and Cable HW250 01240 or TF Kable SOOW12-44.
4. Quantity: 1.
5. Provide a breakout price for owner to purchase additional cables.
6. Connectors:
   a. Straight In-line Cable Plug 42-pin Female:
      1) Amphenol Industrial Star-Line ZPEKJ-28-28-339SN.
   b. Straight In-line Cable Plug 42-pin Male:
      1) Amphenol Industrial Star-Line ZPEKJ-28-28-339PN.

2.18 PLATES AND PANELS

A. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.

B. Custom panels shall be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish unless otherwise noted. Brush in direction of aluminum grain only.

C. Plate finish shall be coordinated with the Owner. Plastic plates are not acceptable.

D. Panel, plate and label engraving shall be 1/8 inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum pushbuttons, letters shall be black.

E. Acceptable Manufacturers for Plates and Panels:
1. Panel Crafters
2. Proco Sound.
3. Whirlwind USA.

2.19 CABLES & WIRING

A. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.).

B. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.

C. Where cables are routed through cable tray, provide tray rated cable of equal specification.

D. Shielded cables located in raceways shall have all over shield with drain wire.

E. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. Cables from Commscope, Gepco, and West Penn are also acceptable provided they meet the performance specifications of the approved listed cables. If field conditions or actual cable pathway requires tray or plenum cable, provide version

of cable that meets required NEC rating. Conduit pathways and raceways shown on the AV drawings have been calculated for appropriate fill based on the diameter and area of the cables listed below. Contractor to verify adequate conduit capacity for alternate cables selected from Commscope, Gepco, and West Penn.

F. Install all conduit, raceway and cabling in accordance with NEC code requirements.

G. Provide Junction Box Speaker (JBS) as required at each cluster, one at Catwalk and one at the array frame. Provide NEMA 1 screw cover enclosures sized appropriately for the number of internal cable terminations. Provide with plywood liner painted with fire-resistant paint on inside of rear for mounting terminal strips.

H. Provide the following:
1. Bowl Loudspeaker Cables:
2. Belden 5000UP - 12 gauge twisted pair, jacketed. CL3 Rated.
3. 70.7 Volt Loudspeaker Cables:
4. Reconnect existing.
5. Microphone Level Cable: Belden 1800B - Single Pair twisted, 24 gauge, shielded, jacketed with gray jacket. Conductor to conductor cable capacitance to be less than 12 pF/ft.
6. Line Level Cable: Belden 1800B - Single Pair twisted, 24 gauge, shielded, jacketed with violet jacket. Conductor to conductor cable capacitance to be less than 12 pF/ft.
7. Control Cables: Belden 53(**)FE (00)(01)(02)(03)(04)(06)(07) Series - 18 gauge with overall shield and appropriate number of conductors.
8. Ethernet Cable: Enhanced Cat 5e, Belden 7934A.
9. Wireless Microphone Antenna Cable: Belden 9258 – RG8/X Type, 16 gauge stranded center conductor, 95% braided shield.
10. Single Mode Fiber Optic Cable: Belden M9W231. 12-Strand tight buffer aluminum interlock armor, single mode enhanced.

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate work with other trades to avoid causing delays in integration schedule.

3.2 INSTALLATION

A. Electronic audio equipment shall be permanently mounted in equipment racks. This does not include the sound reinforcement console which is to be mounted to a custom portable cart.

B. Equipment and materials shall be new and conform to applicable UL or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.

C. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet published manufacturer's specifications.

D. Install mounted equipment with black number 10 button head machine screws with Hex Allen or Square Robinson drive.

E. Provide shaft locks or security covers on non user operated equipment having front panel controls. Install at the conclusion of Acceptance Testing.

F. Audio XLR type connectors not a part of manufactured electronic device or component shall have gold plated contacts. This includes both cable and chassis mount connectors on all interconnect cables, plate and panels for all audio systems.

G. Install XLR type connector wired pin 2 high, pin 3 low, and pin 1 screen (shield).

H. Provide all ceiling and wall mounted speaker grilles and enclosures with a manufacturer applied finish to match the surrounding ceiling or wall color as directed by Owner.

I. Mount equipment and enclosures plumb and square. Permanently installed equipment to be to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where State of Texas codes require such installation.

3.3 LABELING

A. The label nomenclature shall correspond to the Owner's directed signage and way finding program.

B. Provide engraved laminate label adjacent to the front and rear of equipment mounted in housing. Install in a plumb, level, and permanent manner. Provide rear mounted labels on equipment mounted in furniture console.

C. Provide engraved label over each user-operated control that describes the function or purpose of the control. Adjust label size to fit available space.

D. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on system schematic drawing.

E. Provide logical and legible cable and wiring label permanently affixed for easy identification.

F. Labels on cables shall be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.

G. Wiring designator shall be an alpha-numeric code unique for each cable.

H. Locate the cable designator at the origination and destination of each circuit within 75 mm of the point of termination or connection. Circuits that have intermediate splice points shall have the same designator throughout with an additional suffix to indicate each segment.

3.4 ENGRAVING

A. Text font shall be 1/8 inch block sans serif characters unless noted otherwise.

B. On dark materials provide white characters. On stainless steel, brushed natural aluminum plates or light-colored materials, provide black characters.

C. Provide at least three lines of text with first line listing the general device name, e.g., POWER AMPLIFIER, EQUALIZER. Second line to include schematic reference of the device, e.g., PA. The bottom line to indicate what other devices or areas this equipment controls, i.e., FEEDS HF-3&4 or FEEDS XOVER-3.

D. Equipment label shall be black with white characters unless otherwise indicated.

3.5 EQUIPMENT HOUSING

A. Install equipment and amplifiers in equipment racks according to manufacturer's recommendations.

B. Provide adequate ventilation or fans to maintain a maximum rack temperature of 90 degrees Fahrenheit.

C. Floor racks located in equipment rooms to be mounted on wood riser-minimum of 2 inches high.

D. Provide unused panel space with blank or vent panels, painted to match housing.

E. Provide rear support for housing mounted equipment greater than 15 inches deep.

F. Allow a minimum of 20% open rack space.

G. Locate operator usable equipment and patch panels at a convenient height.

H. Key door locks for each housing type alike.

I. Looking at the housing from the rear, install AC power and ground cabling on the left; audio and video cabling on the right.

J. Provide lights mounted in the top of each rack to illuminate the interior for service or maintenance. Lights to be individually switchable and placed so as to provide maximum illumination throughout the rack. Lamps to be LED style.

K. Do not mount panels or equipment on the rear housing rails. Use rear rack rails for support of any rack equipment over 16-inches in depth.

3.6 PATCH PANELS

A. Provide unique colored identification strips for each major connector grouping (i.e., microphone inputs, line inputs, console inputs, console outputs, inserts, etc.).

B. All patch panels shall be in consecutive rack spaces located at a level to comfortably read and use the panels.

C. Patch panels shall be located in Control Room racks.

D. Locate inputs from microphone input plates and floor panels near the top of the patch bay.

E. Locate sends and tie lines near the bottom of the patch bay.

F. Locate "Interconnect Panel" adjacent to patchbay.

G. Patch panels shall be normalled at the direction of the Owner following the first two regular events.

3.7 SYSTEM CABLING AND WIRING

A. General:
   1. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signals, float cable shield at the output of source device. Shields

not connected shall be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.

2. Exercise care in cabling and wiring. Damaged cables or wire will not be accepted. Isolate cables and wires of different signal levels. Separate or re-route to reduce channel crosstalk or feedback oscillation in any amplifier section. Keep cabling separated into groups as described in ASDI article 12.3.
3. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Operator's Consultant. Where spade lugs are used, crimp properly with ratchet type tool.
4. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
5. Provide splice free wiring and cabling from origination to destination.

B. Housing:
1. Cabling entering equipment housings or splices in junction boxes should connect via connector termination or terminal block equal to Cinch 140 -142 series.
2. Install terminal block fully exposed, labeled, and mounted on 19 mm plywood board painted flat black with fire retarding paint.
3. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack while allowing for service and testing. Provide horizontal support bars if cable bundles sag.
4. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
5. Provide plastic cable ties or lacing twine to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
6. Install cabling with connections completely visible and labeled.
7. Provide termination resistors of 5 per cent tolerance; fully visible and not concealed within equipment or connectors.

3.8 AC POWER AND GROUNDING:

A. Coordinate final connection of power and ground wiring to housings. Hard-wire power wiring directly to power contactors or internal AC receptacles to ensure uninterrupted operation.

B. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing plus an additional two spare outlets.

C. Provide a copper ground buss in each housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.

3.9 LOUDSPEAKER SUSPENSION

A. Loudspeakers shall be suspended at the operating position in a safe, secure and permanent manner.

B. The aiming direction of all loudspeakers shall be adjustable by ±15 degrees vertically.

C. All speaker enclosures being flown or suspended to have internal mounting brackets to distribute the load to the other faces of the enclosures. Provide internal bracing on cabinets that do not have factory installed bracing.

D. All speaker enclosures to have permanently attached grilles with no company logos or names visible without prior approval by the Owner.

E. Structural support members to have a safety factor of at least 5. Mounting hardware and wire rope to have a safety factor of 8. All fasteners to be graded and certified for use in the intended applications. Overhead suspension hardware shall comply with ASME B30.20 standards and all applicable local building and safety codes.

F. Overhead suspension hardware must be of a type that includes product traceability controls.

G. Rigging, mounting and support systems for loudspeakers shall be designed and sealed by a registered professional engineer licensed to practice in the State of Texas. Once the systems are installed, the engineer shall physically inspect the methods and means used to verify compliance with the original design.

H. Paint speakers, supports and related hardware as directed by Owner.

I. Unless otherwise noted, speakers mounted to building structure are to be positioned with the long dimension horizontal and the high frequency horn rotated to maintain the wider dispersion in the horizontal plane. Speakers mounted on poles are to be oriented vertically, as shown in the drawings.

3.10 CONTRACTOR COMMISSIONING

A. Prior to energizing or testing the system, ensure the following:
1. All product is installed in a proper and safe manner per the manufacturer's instructions.
2. Insulation and shrink tubing are present where required.
3. Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. All labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed and disposed off-site.
7. All products are neat, clean and unmarred and parts securely attached.
8. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
9. Electronic devices are properly grounded.

B. Prior to energizing the system, perform the following tests in compliance with applicable EIA standards. Record the results of each test in the Project Record Manual.
1. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
2. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
3. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be 1000 ohms or greater.

C. Impedance Tests:
1. Prior to energizing the system, perform the following tests in compliance with applicable EIA standards. Record the results of each test in the Project Record Manual.
2. Measure the impedance of each speaker line leaving the equipment racks. For full range devices, use a frequency of 1000 Hz and 100Hz, for band limited devices, use a frequency appropriate for the operating range of the transducer. When documenting the results of these tests, include the calculated impedances based on number of units on a line and the size and distance of the run.
3. Correct any field readings that differ more than 20% from the calculated impedances.
4. Include the results of the tests in the Project Record Manual.

D. Fiber Optic Cable test:
   1. Test FO cable in accordance with ANSI/TIA/EIA-568-B.3 and any applicable amendments
   2. Provide two hard copies and CDR of recorded test results IN THE Project Record Manual.

E. Category (Data) Cable test:
   1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, and opens. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a level IIe or level III test unit for category 5e or category 6, performance compliance, respectively.
   2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
   3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
   4. Provide two hard copies and CDR of recorded test results in the Project Record Manual.

F. Speaker Aiming Test:
   1. Provide a temporary means by which to wire and power the various loudspeaker types to provide the opportunity for fine cabinet aiming adjustments to be made.
   2. Once these fine aiming adjustments are made, other like loudspeakers can be set using the same aiming angles.
   3. Notify Owner two weeks prior to test.

G. Speaker Circuit Verification Test:
   1. Provide a low level, band limited test signal to each amplifier input.
   2. Turn on one channel of Amplifier #1 and verify that the correct speaker or group of speakers is operating. Correct any wiring or other problems found.
   3. In a similar manner, check each channel of all remaining amplifiers and their respective speaker circuits.
   4. Include the results of the tests in the Project Record Manual.

H. Constant Voltage Speaker Test:
   1. Play music, pink noise or other distinctive audio signal through each group of constant voltage speakers. Only one amplifier channel should be on at a time.
   2. Walk the area covered by the speakers.
   3. Verify that each speaker is operating and that there are no significant changes in volume level from one speaker to the next.
   4. Verify that the extent of coverage is consistent with the areas indicated on the drawings.

I. Speaker Polarity Verification Test:

1. Use an electronic polarity checker, TEF-20, SYSID, SIM II, or other similar device to test each reinforcement speaker. All speakers should have the same relative polarity.
2. Follow manufacturer's recommendations in conducting the tests.
3. In a similar manner, check all distributed speakers to ensure they have the same polarity.
4. Include the results of the tests in the Project Record Manual.

J. System Gain Adjustment:
1. Adjust each active device for proper gain from the console output to the input of the amplifier.
2. Record the output levels of each device in the Project Record Manual.

K. Signal Delay Adjustment:
1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and delayed speakers.
2. Using a TEF 20, SYSID, Smaart, SIM II, or other acceptable time based measurement system, measure the arrival time of the distant signal and then measure the arrival of the local signal.
3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1 ms of the arrival of the distant signal.
4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.

L. Active Crossover Network Adjustment:
1. Adjust each active crossover to provide the appropriate bandwidth and slope rate for the speaker system it controls.
2. Multiple crossovers controlling speakers in identical areas should be set identically.
3. Record the settings of all the crossovers in the Project Record Manual.

M. Amplifier Level Adjustment - Main Reinforcement System:
1. Adjust the gain of each amplifier to provide a consistent and appropriate volume level throughout the facility.
2. Begin by connecting a pink noise source to one input of the mixing console. Adjust the console output to -10 dB on the VU meter.
3. Adjust the appropriate amplifiers to achieve 85 dBA in the area covered by one section speakers. Use a calibrated sound level meter to make the measurement.
4. If the test group of speakers employs an active crossover, use a Ivie IE-30, TEF 20, SYSID, Smaart or SIM II to balance the spectrum by adjusting the amplifier for each band.
5. Once the initial speakers have been properly adjusted, begin adding the speakers in each adjacent areas and repeating the same adjustments.
6. When a given area or seating level has been completed, move to the next lower area and repeat the tests and adjustments for that area.
7. Amplifier settings for speakers covering similar seating areas should have the same gain settings. Investigate and correct any occurrences where an amplifier deviates more than 2 dB from the average.
8. Amplifiers should be set to provide an average of 85 dBA ±1.5 dB throughout each seating section.
9. Record the setting of each amplifier in the Project Record Manual and keep backup copies of the data file on disk.

N. Amplifier Level Adjustment - 70 Volt Systems:

1. Adjust the level of 70 volt systems to achieve a volume level appropriate for their location and intended use.
2. After setting the amplifier level for each system, play a pink noise signal over the speakers and walk through each area. Using a sound level meter, identify any areas where the SPL changes by more than 3 dB. Identify the cause of the change and where it is due to mounting height or architectural differences, adjust the transformer taps of the affected speakers to bring the sound level within range. Include any changes on the Record Documents.

O. Headroom Verification Test:
1. Once the preceding tests and adjustments have been completed, play a variety of musical programs through the system. Amplifiers should be off for this test.
2. Adjust the console gain to achieve peak output levels of +6 VU on the console meters.
3. Observe if any of the components indicate clipping or less than 3 dB of headroom.
4. Replace the musical program with a steady 1000 Hz sine wave. Connect an oscilloscope or similar device to selected amplifiers in each portion of the reinforcement system.
5. Increase the output level of the console until the signal displayed on the oscilloscope begins to show distortion. Record the dB level of the signal from the console and which component in the chain is creating the distortion in the Project Record Manual.

P. Remote Input Verification Test:
1. Using a microphone or portable signal generator, connect to each microphone receptacle throughout the facility.
2. Verify that the receptacle under test appears at the correct position on the patch bay and is operating properly.
3. In a similar manner, check all remote tie lines and media related lines for correct wiring and labeling.

Q. System Equalization:
1. Using a TEF 20, SYSID, SMAART or a spectrum analyzer with both 1/3 band and narrow band display, equalize all loudspeaker systems to provide a suitable frequency response.

R. Verify system gain and amplifier levels:
1. Provide follow-up refinements to the equalization based on requests from the Owner.
2. When all the above tests have been completed and the system is ready for observation, formally notify the Owner at least seven working days prior to Acceptance Testing. Include in this notice copies of all data recorded, date each test was completed and the results of each test. All test data shall be available during the observation process.

3.11 TEST EQUIPMENT

A. Furnish the following equipment as requested. Equipment to be available for the entire test period through final system testing.
1. Sound Level Meter : ANSI S1.4-1971 Type SEA with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
2. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100 kohms.
3. Multimeter-Measurement range, DC to 20kHz, 100 mV to 300V, 10 ma to 10 A.
4. Audio Oscillator: bandwidth 20 Hz to 20k Hz ±1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
5. Dual trace oscilloscope.
6. Ladders and scaffolding necessary to inspect all speakers.

7. Temporary 1000 foot microphone cable for testing purposes.
8. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and charger along with holster for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

END OF SECTION 27 41 16